

CLAIMS

What is claimed is:

1. A reactive material, comprising:
reactive material components from at least two of the following three component categories:
at least one fuel;
at least one oxidizer; and
at least one class 1.1 explosive;
wherein the reactive material is suitable for use in a reactive material bullet and formulated to provide at least one of an overpressure of greater than approximately 9 pounds per square inch at a radial measurement of 12 inches from a point of impact on a target, a hole greater than approximately 2 square inches at an optimum penetration level in a target, and pressure, damage, and a flame when the reactive material bullet impacts a target.
2. The reactive material of claim 1, wherein the at least one fuel is selected from the group consisting of a metal, a fusible metal alloy, an organic fuel, and mixtures thereof.
3. The reactive material of claim 1, wherein the at least one oxidizer is selected from the group consisting of an inorganic oxidizer, sulfur, a fluoropolymer, and mixtures thereof.
4. The reactive material of claim 1, wherein the at least one fuel comprises a metal selected from the group consisting of hafnium, tantalum, nickel, zinc, tin, silicon, palladium, bismuth, iron, copper, phosphorous, aluminum, tungsten, zirconium, magnesium, boron, titanium, sulfur, magnalium, and mixtures thereof.
5. The reactive material of claim 1, wherein the at least one fuel comprises an organic fuel selected from the group consisting of phenolphthalein, hexa(amine)cobalt(III)nitrate, and mixtures thereof.

6. The reactive material of claim 1, wherein the at least one fuel comprises a fusible metal alloy including at least one metal selected from the group consisting of bismuth, lead, tin, cadmium, indium, mercury, antimony, copper, gold, silver, and zinc.

7. The reactive material of claim 1, wherein the at least one fuel comprises a fusible metal alloy having a constituency of about 57% bismuth, about 26% indium, and about 17% tin.

8. The reactive material of claim 1, wherein the at least one oxidizer is selected from the group consisting of ammonium perchlorate, potassium perchlorate, potassium nitrate, strontium nitrate, basic copper nitrate, cupric oxide, iron oxide, bismuth trioxide, tungsten oxides, molybdenum trioxide, and mixtures thereof.

9. The reactive material of claim 1, wherein the at least one oxidizer is selected from the group consisting of polytetrafluoroethylene, a thermoplastic terpolymer of tetrafluoroethylene, hexafluoropropylene, and vinylidene fluoride, a copolymer of vinylidene fluoride-hexafluoropropylene, and mixtures thereof.

10. The reactive material of claim 1, wherein the at least one class 1.1 explosive is selected from the group consisting of trinitrotoluene, cyclo-1,3,5-trimethylene-2,4,6-trinitramine, cyclotetramethylene tetranitramine, hexanitrohexaazaisowurtzitane, 4,10-dinitro-2,6,8,12-tetraoxa-4,10-diazatetracyclo-[5.5.0.0^{5,9}.0^{3,11}]-dodecane, 1,3,3-trinitroazetidine, ammonium dinitramide, 2,4,6-trinitro-1,3,5-benzenetriamine, dinitrotoluene, dinitroanisole, and mixtures thereof.

11. The reactive material of claim 1, further comprising at least one binder selected from the group consisting of polyurethanes, epoxies, silicones, glycidyl azide polymers, polyesters, nylons, cellulose acetate butyrate, ethyl cellulose, graphite, (bis(2,2-dinitropropyl)acetal/bis(2,2-dinitropropyl)formal), and mixtures thereof.

12. The reactive material of claim 1, wherein the reactive material comprises tungsten, potassium perchlorate, and a copolymer of vinylidene fluoride-hexafluoropropylene.
13. The reactive material of claim 1, wherein the reactive material comprises bismuth, indium, tin, potassium perchlorate, cellulose acetate butyrate, and (bis(2,2-dinitropropyl)acetal/bis(2,2-dinitropropyl)formal).
14. The reactive material of claim 1, wherein the reactive material comprises aluminum, zirconium, and a copolymer of vinylidene fluoride-hexafluoropropylene.
15. The reactive material of claim 1, wherein the reactive material comprises magnesium, cupric oxide, and a copolymer of vinylidene fluoride-hexafluoropropylene.
16. The reactive material of claim 1, wherein the reactive material comprises hafnium and a thermoplastic terpolymer of tetrafluoroethylene, hexafluoropropylene, and vinylidene fluoride.
17. The reactive material of claim 1, wherein the reactive material comprises aluminum, boron, and a copolymer of vinylidene fluoride-hexafluoropropylene.
18. The reactive material of claim 1, wherein the reactive material comprises zirconium and polytetrafluoroethylene.
19. The reactive material of claim 1, wherein the reactive material comprises bismuth, indium, tin, and potassium perchlorate.
20. The reactive material of claim 1, wherein the reactive material comprises cyclotetramethylene tetranitramine, cellulose acetate butyrate, and (bis(2,2-dinitropropyl)acetal/bis(2,2-dinitropropyl)formal).

21. The reactive material of claim 1, wherein the reactive material comprises aluminum, potassium perchlorate, silicon, and a thermoplastic terpolymer of tetrafluoroethylene, hexafluoropropylene, and vinylidene fluoride.

22. The reactive material of claim 1, wherein the reactive material comprises bismuth, indium, tin, aluminum, silicon, sulfur, potassium perchlorate, bisazidomethyloxetane, glycidylazide plasticizer, and (bis(2,2-dinitropropyl)acetal/bis(2,2-dinitropropyl)formal).

23. The reactive material of claim 1, wherein the reactive material comprises cyclotetramethylene tetranitramine, cellulose acetate butyrate, (bis(2,2-dinitropropyl)acetal/bis(2,2-dinitropropyl)formal), aluminum, potassium perchlorate, silicon, and a thermoplastic terpolymer of tetrafluoroethylene, hexafluoropropylene, and vinylidene fluoride.

24. The reactive material of claim 1, wherein the reactive material comprises zirconium and a thermoplastic terpolymer of tetrafluoroethylene, hexafluoropropylene, and vinylidene fluoride.

25. A reactive material projectile, comprising:
a case having a reactive material disposed therein, and a tip, wherein the reactive material comprises reactive material components from at least two of the following three component categories:

- at least one fuel;
- at least one oxidizer; and
- at least one class 1.1 explosive,

and wherein the reactive material is formulated to provide at least one of an overpressure of greater than approximately 9 pounds per square inch at a radial measurement of 12 inches from a point of impact on a target, a hole greater than approximately 2 square inches at an optimum penetration level in a target, and pressure, damage, and a flame when the reactive material projectile impacts a target.

26. The reactive material projectile of claim 25, wherein the reactive material is formulated to initiate upon impact with a target.

27. The reactive material projectile of claim 25, wherein the reactive material comprises at least one fuel selected from the group consisting of a metal, a fusible metal alloy, an organic fuel, and mixtures thereof.

28. The reactive material projectile of claim 25, wherein the reactive material comprises at least one oxidizer selected from the group consisting of an inorganic oxidizer, sulfur, a fluoropolymer, and mixtures thereof.

29. The reactive material projectile of claim 25, wherein the reactive material comprises at least one fuel selected from the group consisting of hafnium, tantalum, nickel, zinc, tin, silicon, palladium, bismuth, iron, copper, phosphorous, aluminum, tungsten, zirconium, magnesium, boron, titanium, sulfur, magnalium, and mixtures thereof.

30. The reactive material projectile of claim 25, wherein the reactive material comprises at least one fuel selected from the group consisting of phenolphthalein, hexa(amine)cobalt(III)-nitrate, and mixtures thereof.

31. The reactive material projectile of claim 25, wherein the reactive material comprises a fusible metal alloy having at least one metal selected from the group consisting of bismuth, lead, tin, cadmium, indium, mercury, antimony, copper, gold, silver, and zinc.

32. The reactive material projectile of claim 25, wherein the reactive material comprises a fusible metal alloy having a constituency of about 57% bismuth, about 26% indium, and about 17% tin.

33. The reactive material projectile of claim 25, wherein the reactive material comprises at least one oxidizer selected from the group consisting of ammonium perchlorate, potassium

perchlorate, potassium nitrate, strontium nitrate, basic copper nitrate, cupric oxide, iron oxide, bismuth trioxide, tungsten oxides, molybdenum trioxide, and mixtures thereof.

34. The reactive material projectile of claim 25, wherein the reactive material comprises at least one oxidizer selected from the group consisting of polytetrafluoroethylene, a thermoplastic terpolymer of tetrafluoroethylene, hexafluoropropylene, and vinylidene fluoride, a copolymer of vinylidene fluoride-hexafluoropropylene, and mixtures thereof.

35. The reactive material projectile of claim 25, wherein the reactive material comprises at least one class 1.1 explosive selected from the group consisting of trinitrotoluene, cyclo-1,3,5-trimethylene-2,4,6-trinitramine, cyclotetramethylene tetranitramine, hexanitrohexaazaisowurtzitane, 4,10-dinitro-2,6,8,12-tetraoxa-4,10-diazatetracyclo-[5.5.0.0^{5,9}.0^{3,11}]-dodecane, 1,3,3-trinitroazetidine, ammonium dinitramide, 2,4,6-trinitro-1,3,5-benzenetriamine, dinitrotoluene, and mixtures thereof.

36. The reactive material projectile of claim 25, further comprising at least one binder selected from the group consisting of polyurethane, epoxies, polyesters, nylons, cellulose acetate butyrate, ethyl cellulose, silicone, graphite, and (bis(2,2-dinitropropyl)acetal/bis(2,2-dinitropropyl) formal).

37. The reactive material projectile of claim 25, wherein the reactive material comprises tungsten, potassium perchlorate, and a copolymer of vinylidene fluoride-hexafluoropropylene.

38. The reactive material projectile of claim 25, wherein the reactive material comprises bismuth, indium, tin, potassium perchlorate, cellulose acetate butyrate, and (bis(2,2-dinitropropyl) acetal/bis(2,2-dinitropropyl) formal).

39. The reactive material projectile of claim 25, wherein the reactive material comprises aluminum, zirconium, and a copolymer of vinylidene fluoride-hexafluoropropylene.

40. The reactive material projectile of claim 25, wherein the reactive material comprises magnesium, cupric oxide, and a copolymer of vinylidene fluoride-hexafluoropropylene.

41. The reactive material projectile of claim 25, wherein the reactive material comprises hafnium and a thermoplastic terpolymer of tetrafluoroethylene, hexafluoropropylene, and vinylidene fluoride.

42. The reactive material projectile of claim 25, wherein the reactive material comprises aluminum, boron, and a copolymer of vinylidene fluoride-hexafluoropropylene.

43. The reactive material projectile of claim 25, wherein the reactive material comprises zirconium and polytetrafluoroethylene.

44. The reactive material projectile of claim 25, wherein the reactive material comprises bismuth, indium, tin, and potassium perchlorate.

45. The reactive material projectile of claim 25, wherein the reactive material comprises cyclotetramethylene tetranitramine, cellulose acetate butyrate, and (bis(2,2-dinitropropyl)acetal/bis(2,2-dinitropropyl)formal).

46. The reactive material projectile of claim 25, wherein the reactive material comprises aluminum, potassium perchlorate, silicon, and a thermoplastic terpolymer of tetrafluoroethylene, hexafluoropropylene, and vinylidene fluoride.

47. The reactive material projectile of claim 25, wherein the reactive material comprises bismuth, indium, tin, aluminum, silicon, sulfur, potassium perchlorate, bisazidomethyloxetane, glycidylazide plasticizer, and (bis(2,2-dinitropropyl)acetal/bis(2,2-dinitropropyl)formal).

48. The reactive material projectile of claim 25, wherein the reactive material comprises cyclotetramethylene tetranitramine, cellulose acetate butyrate, (bis(2,2-dinitropropyl)acetal/

bis(2,2-dinitropropyl)formal), aluminum, potassium perchlorate, silicon, and a thermoplastic terpolymer of tetrafluoroethylene, hexafluoropropylene, and vinylidene fluoride.

49. The reactive material projectile of claim 25, wherein the reactive material comprises zirconium and a thermoplastic terpolymer of tetrafluoroethylene, hexafluoropropylene, and vinylidene fluoride.